Modeling the Pro-Forma: Integrating Financial Analysis with Site-Responsive Urban Design

Tim Love
Ryan Sullivan

Tim Love
Boston
www.architecture.neu.edu
www.utiledesign.com
Tenured Associate Professor, Northeastern University School of Architecture, and coordinator of the undergraduate urban housing studios and the graduate-level urban design research semester. Founding Principal of Utile, Inc., a Boston-based architecture and urban design firm that focuses on central Boston urban projects and planning initiatives. On-call urban planning and design review consultant for the Massachusetts Port Authority and the Massachusetts Development Finance Agency. Frequent contributor to the Harvard Design Magazine. Former Lecturer in the Department of Architecture, Harvard Graduate School of Design.

Ryan Sullivan
Boston
www.utiledesign.com
Urban designer at Utile, Inc., a Boston-based architecture and urban design firm that focuses on central Boston urban projects and planning initiatives. Ryan has a special interest in design guidelines, form-based codes, master plans and development studies with a specific expertise in information design and visual thinking. Before joining Utile, Ryan worked as an urban designer in Portland, Oregon and a Fulbright researcher in Copenhagen, Denmark.
Modeling the Pro-Forma: Integrating Financial Analysis with Site-Responsive Urban Design

Tim Love
Ryan Sullivan

In the high-value downtowns of North America, large-scale buildings and associated public spaces typically result from protracted negotiations between private real estate developers and the public over the project’s height, density and programmatic makeup. This paper argues for a new methodology that integrates financial modeling with physical modeling to empower stakeholders to make smarter decisions about form, density, public benefits and financial returns in a streamlined, more integrated process.

Background

There are a host of recent American mega projects all of which involve long negotiations between project stakeholders. Columbus Center in Boston, an over one-million square foot development planned to span over a depressed highway and rail line is on a site adjacent to the Back Bay, an important historic residential and commercial district. Atlantic Yards in Brooklyn, a Gehry Partners-designed mixed-use complex, includes office buildings, apartments and a new home for one of the New York City region’s basketball teams. Recently, Hudson Yards, also in New York City, is yet another large tract of land that could be reclaimed by decking over transportation infrastructure. A Hudson Yards request for proposals was recently issued for developer-architect teams, generating a fresh debate. The financial logic of such projects is predicated on building the minimum square footage necessary to generate, at the very least, enough revenue to pay for the decking over the railroad tracks and/or highway.

The economics of large development projects are also saddled with other responsibilities that affect the balance of the financial spreadsheet. Most North American municipalities, for example, now require a specific minimum percentage of affordable housing to be included within any residential proposal. The inclusion of “at cost” space for cultural and civic institutions is often mandated or encouraged to garner public support from elected officials. In order to support these programmatic add-ons, internal subsidies must be generated from the projected revenue stream of the development, creating additional incentives for increased development density.

The political impact of this equation is well-known. As Robert Campbell, the architecture critic of the Boston Globe spelled out recently: “(One) way to work the game is to keep zoning so restrictive that almost any new building is technically illegal. In that case, each building needs some kind of special permission. In return for granting permission to break the rules, the city negotiates a trade, in which it will gain some kind of public benefit – maybe some off-site affordable housing, let’s say. Every building becomes a deal between the developer and the city. And the bigger the building, the bigger the benefit it can spin off. Underfunded city governments are thus under constant pressure to allow bigger and bigger buildings, regardless of their quality or impact.”

Within a framework where civic bonuses are traded for additional density, the quality of design itself can become part of the calculus. An architectural firm with a well-established public relations apparatus can help improve the political context for negotiations. For Forest City, the developer of the huge Atlantic Yards project in Brooklyn, NY, the choice of Frank Gehry made business sense despite his relatively higher design fee. The cultural significance of a proposed Gehry design earned the developers the right to build more densely than if they had hired a more standard New York commercial firm. In a sense, the additional design and consulting fees required to carry out a Gehry project – the result of the necessary redundancy of a local “executive architect” and the phalanx of equally high-end sub-consultants – is rationalized through the analysis of the full balance of the financial pro-forma. Gehry and his partners can generate more potential development revenue (through additional density) than the delta in design costs. In such cases, design has true economic value.

At the same time, large projects that exceed as-of-right zoning are typically subject to design review by planning agencies, redevelopment authorities and special
commissions that are formed by government agencies for specific projects. Design reviewers can be professionals on staff in government agencies and/or panels of architects and community leaders invited for specific projects or terms of service. Their cumulative comments can have a large impact on the shape and maximum height of the building, the mix of functions and the overall density. As a result, the final total area and the mix of programmatic components cannot be known when the planning of a large urban project is launched. The inability to predict the final outcome of the design and approvals process limits pre-construction financing sources and requires sophisticated metrics for balancing risk and reward.

The buildings that result from this type of design review process are typically more complex, due to pressures from design review panels for new developments to respond sensitively to adjacent existing urban fabric. In Boston, for example, recent high density projects on urban infill sites have lower level podiums that fill in the street wall at a range of heights to feather into the adjacent fabric. As they rise, these developments have a series of setbacks transitioning the massing from street wall infill to tower to help negotiate between the scale of the existing neighborhood and the highest components of the project. The fully permitted but unbuilt Columbus Center project in Boston has been carefully sculpting as a result of a highly protracted community design review process. The resulting setbacks and articulated middle-scale massing components have contributed to an unusually high project cost, as compared to developments of similar scale on less sensitive urban sites.

Architectural expression is also often more elaborate for negotiated projects than as-of-right development given the demand for architectural quality as a trade-off for increased density. Rather than simple off-the-shelf curtain walls, a complex range of cladding solutions are used to break down the scale of the development and add texture and shadow to the elevations. Examples include self-consciously “contextual” projects such as Columbus Center and Atelier 505 in Boston’s South End, and even modernistic interventions such as Handel and Partners Millennium Project in Downtown Boston. Although served by a single elevator core, the residential component of Atelier 505 is broken down into three independently expressed but conjoined volumes: a brick loft building, a limestone tower and a series of brick-clad rowhouses that face similarly-scaled existing buildings across the street at the back of the project. Again, this demand for the scale of additive urbanism has an impact on the financial pro-forma since increased construction cost may require additional density to re-balance the financial return of the development.

Despite the clear conceptual relationships between socially beneficial programmatic add-ons, building shape, design quality and the need for increased revenue within the logic of the financial pro-forma, the political arena within which a project is shaped through negotiated “trade-offs” has not been tackled through design methodology.

Argument

Although BIM (Revit, ArchiCAD and VectorWorks) and quick digital modeling software (SketchUp) are becoming ubiquitous in architecture firms for building design, these tools are not yet being used to model and analyze development options at the earliest stages of planning. Our team at Utile, a Boston-based planning and architecture firm, has harnessed the inherent capabilities of digital software to better inform these kinds of processes by making transparent the design implications of negotiations about density, program mix, building configuration, design expression, environmental and transportation impacts.

Our methodology tests the economic viability of program choices and massing configurations in real time by manipulating massing models created with BIM software. Floor-to-floor heights for specific uses and net-to-gross ratios, among other attributes, are built into the parametric models, to allow for the rapid quantification of compositional choices. This data, in turn, is directly linked to financial pro-formas that include assumptions about construction costs and other variables. Within the logic of this methodology, the costs of other non-revenue-generating programs can be evaluated, both within the configuration of the building mass, but also as a component of the financial model.

This technique seeks to establish market expectations for return on investment (roi) for the specific project. The internal rate of return is typically established by the likely pool of investors and informed by perceptions of risk associated with the project. Once established, this value of profit becomes the bottom line for negotiations about density and program mix as a component of the parametric model. This methodology converts digital models of design scenarios into a kind of three-dimensional spreadsheet, with profit on top of the break-even return indicated with a change of color and tone. In the case of a development proposal that includes both
the cost of decking over a railroad yard and specific requirements for affordable housing, the diagrammatic content of the massing model can be enriched by showing how much of the volume of the building is necessary to pay for those components. By color-coding attributes of the proposal in both the massing model and spreadsheet, the direct impact on programmatic and compositional choices can be tracked in the financial model. The result is a process that demonstrates the physical implications, in terms of increased density, of the addition of social programs or less profitable, but socially and politically advantageous program mixes.

There are several important audiences for both the process and information provided. The first is the design team and the developer-client. Rather than a call-and-response process that requires the development of “what if?” design scenarios that are then evaluated by the financial team, the architect (controlling the computer mouse) can see the financial implications of design decisions instantaneously. Likewise, the developer-client can understand the close interrelationship between form-making and potential profit. Face-to-face meetings are therefore more like collaborative design workshops than discussions around static representations of the design process. Perhaps even more significantly, this flexible and responsive tool can make more transparent the financial consequences of design changes to the myriad of stakeholders who shape a large-scale urban development.

Case Studies

Two development projects within the built-up and historic core of Boston will serve as case studies of this methodology. Each project uses similar techniques, but the scope, physical characteristics and audience of the design problem are quite disparate.

In both projects, the goal was not to find the most financially efficient solution, but rather to set realistic expectations about the financial consequences of specific design recommendations. In both cases, urban design, environmental and transportation considerations set important parameters in terms of building configuration and cladding solutions. Financial analysis resulting from digital model scenarios – along with probable required social programming “add-ons” – has yielded the total density and mix of uses to internally subsidize the desired solution.

Case Study: Infill Development

The first case study is a series of development and urban design proposals that were tested for a developer who had purchased eleven historic warehouse buildings in Boston’s Fort Point District.

The entire Fort Point District was originally built by the Boston Wharf Company in late 19th and early 20th century on land created when that portion of Boston Harbor was filled. The Fort Point District was conceived as a self-sufficient commercial district with a network of streets and over thirty-five buildings that served as the transportation nexus between ship and rail for the Boston Wharf Company’s American operations. Since the majority of Fort Point’s buildings were built within a ten-year window, the district is remarkably consistent in terms of scale and architectural expression.

Despite the increasing value of the holdings, as a result of the gentrification of other historic neighborhoods in central Boston, the Boston Wharf Company held on to its assets. There was pressure to sell through two successive real estate cycles in the mid-1980s and late-1990s, when the neighborhood was highly coveted by real estate speculators due to the architectural quality of the existing loft buildings and location of the neighborhood immediately adjacent to Boston’s Financial District. Satisfied with the sub-market rents it was receiving from light manufacturing businesses, furniture showrooms, printing companies and artists, Boston Wharf maintained the properties.

When Boston Wharf finally decided to sell off its assets in the area in 2005, three real estate development companies bought the majority of the buildings, resulting in rapid escalation of value and speculation in the properties. In 2007, Mansur, an Indiana-based Real Estate Investment Trust, sold off its assets in the area to Crosspoint, a Boston-area developer with expertise in retail. Utile, Inc. was hired in early 2008 to help Crosspoint position its holdings and find opportunities for improvements to the existing buildings and new development projects. Currently, the buildings house office space for Thomson Financial and its subsidiaries. Utile’s task was to conduct projective scenarios to understand the best sequence of actions for converting a corporate campus (disguised as a loft district) into a vital mixed-use neighborhood, with enough additional space to maintain Thomson Financial as the tenant anchor of the mix.
To help Crosspoint understand its existing portfolio, Utile built a Revit model of the buildings linked to a spreadsheet. The data was organized to allow for rapid prototyping of lease scenarios over the short term and to help quantify the value of new development against current and projected income streams from Thomson Financial leases. Importantly, the model allowed the development team to understand the physical planning and financial implications of adjustments to phased relocation scenarios. The goal was to create new development projects, slipped within the existing neighborhood, to provide new office space for Thomson Financial, freeing historically significant buildings to allow for ground level retail, loft residential projects and office space for boutique tenants (such as advertising and design firms). In addition to providing rapid prototyping and phasing scenarios, the model was used to calculate population densities for different building occupants and to analyze solar orientation, parking and transportation.

The analysis of a range of scenarios identified two development projects that would most efficiently increase the gross square footage of Crosspoint’s holdings, provide a better address and office space for Thomson Financial and allow for a broader range of uses to promote a livelier urban environment. One development project is a relatively small-scale penthouse addition, planned to bridge from an existing parking garage to an adjacent loft building. In this example, the modeling of scenarios indicated that this penthouse addition represented better value than other penthouse addition scenarios, even though it would require Crosspoint to acquire the parking garage from another development entity for its portfolio. The digital modeling of options helped Crosspoint determine that the value of the garage as a development project was higher than its market value as determined by the on-going parking revenue. Crosspoint now has a competitive advantage, since it owns an adjacent building compatible in height and massing with the garage.

The second potential development project, a 300,000 gross square-foot office building and hotel, has larger urban design implications that will determine how the Fort Point District dovetails into larger new commercial developments to the north. Options for the specific massing and programmatic mix were analyzed to understand the financial implications of a complex set of interrelated decisions. The sensitive location of the site – at the edge of the historic Fort Point District but fronting Seaport Boulevard, a new six-lane boulevard with 250-foot tall commercial buildings proposed along its north side – presented significant physical implications to potential development scenarios.

Since any development on the parcel would require zoning variances, arguments for additional height and density would require a persuasive urban design agenda predicated on the need for a building that could navigate the scale shift from an historic neighborhood comprised of buildings of between six and eight stories to a new district whose massing begins at 250 feet. The project was further complicated by the need to acquire the air rights over an existing mass transit station. The design and financial model of scenarios needed to take into account this added complexity.

Among the building configurations proposed was a new street-wall podium of seven and eight stories that would “correct” the ragged existing street wall by replacing existing out-of-scale low buildings with more consistent infill development. This new development, proposed to have brick elevations that mimic the scale, texture and quality of the existing buildings, would serve as the low-rise component of a taller mass that would face the more robust Seaport Boulevard. Additional setback heights were also explored to transition between the new low-rise components and the maximum height of the building, established at 250 feet to match the building heights across the boulevard.

A series of options were studied within this basic framework to determine which configuration would perform best visually within the existing and proposed cityscape, while providing adequate floor plan dimensions for the proposed stacked mix of uses. Eye-level perspectives were the primary method of testing the future perceptual performance of a range of options.

Case Study: Planning Study and Zoning Update

In late 2007, Utile was awarded the contract to complete a comprehensive master plan for one of the two main Downtown commercial districts in Boston. For the purposes of the study, the area was named the Stuart Street area, but the district has historically been associated with the adjacent Back Bay, a historically significant 19th century residential neighborhood. The area of study includes the Hancock Building, an iconic modernist glass tower designed by Harry Cobb of I.M. Pei’s office in the 1970s.
The purpose of the study is to determine the best configuration and program mix for high density development on the remaining potential development parcels in the area, and to make zoning recommendations based on this analysis. Currently, the area falls under several zoning sub-districts that prescribe as-of-right densities that fall below market thresholds for high value office and residential developments that are typical in the Back Bay market. The relatively low-scale development allowed under current regulations, coupled with a regulatory process in the City of Boston that sees zoning variances as the norm rather than exception, means that the final build-out densities of development sites are extremely unpredictable. Once variances are sought, a highly complex iterative review process is triggered that involves the Boston Redevelopment Authority, affected citizens groups (given quasi-official authority by the Mayor) and the Zoning Board of Appeal.

Fatigue of neighborhood associations, the City’s planning agency, and other stakeholders that participated in lengthy negotiations for each individual project lead to a call for new higher density zoning and a process that would discourage the necessity for variances. In a deal that was struck with the Boston Redevelopment Authority, the new process would determine thresholds for market-ready development densities and the affected communities would agree to higher as-of-right densities in exchange for specific guidelines for the shape of the buildings and the way that program was distributed.

The study will result in recommendations for new form-based zoning rules for the area. Financial analysis of scenarios will help frame the range of realistic densities to ensure that the new form-based zoning recommendations intelligently address market realistic building forms, footprints and uses. The hope is that the new zoning will encourage developers to work within the as-of-right zoning envelope and will not seek variances – the typical routine for permitting projects in the area for the past twenty years. The benefits to developers of proposing as-of-right development include a shorter and more predictable permitting process, a more stable understanding of true parcel value, helping to stabilize the speculative market, and a set of standards for urban design quality.

Like the Crosspoint project described above, building configuration recommendations are the result of an urban design agenda that seeks to infill vacant and underdeveloped parcels with development that can mend the street wall and contribute to ground level activity. Since the Stuart Street plan will result in an overarching zoning code and not a specific building design, rules are being written that make the street wall podium as site-responsive as possible while allowing for some flexibility to accommodate contemporary expectations for floor-to-floor heights and realistic plan setback dimensions based on logical structural grids. While still early in the planning process, the code that is emerging strives for a complex street wall podium that responds to the cornice heights of all significant historical buildings that surround the development parcel, either at the party wall or across the street. By filling missing-tooth vacant and underdeveloped parcels in the district with new development, active sidewalk-level uses and appropriately-scaled mid-rise podiums, denser as-of-right development can be more quickly approved by groups representing the affected nearby residential neighborhoods.

Once the design parameters for site-responsive street wall podiums have been met, a BIM model of a typical development parcel was constructed to determine the range of development and densities required to achieve a realistic range of financial the returns. This financially-driven baseline scenario allows the stakeholders to understand the minimum thresholds for economically viable development. Analysis was done for a range of program types including for-sale and rental residential, office, hotel and retail. The dimensions of some development sites precluded office program (above ground-level retail) ground-leaf market to accommodate the relatively larger floor plates as compared to residential and hotel towers. The massing models of development scenarios were color-coded to demonstrate how much of the development was generating the “break-even” costs – paying for added costs such as deck over transportation infrastructure or providing required affordable housing – and how much was being counted as profit per an internal rate of return required by the market. Additionally, the BIM model was used to assess the development scenarios’ contribution to city-wide urban design issues, including view corridors and the design of the skyline, as well as shadow, parking and transportation impacts.

While community groups at first argued for the least dense viable development (yielding the smallest acceptable threshold of return), a case is being made that the new zoning should be positioned for the middle of the market, since as-of-right zoning that is too strict will throw development under new zoning back into a process that encourages variances as the typical regulatory path. The Stuart Street area will be a test case to demonstrate whether the market rewards zoning that
supports market-savvy as-of-right development versus the variance-laden development and attenuated regulatory process typical of the rest of Boston.

Conclusion

As the two case studies demonstrate, the ability to generate three-dimensional models of development scenarios linked to a financial model has several advantages for the architect and development team. Significantly, the proposed process encourages a more collaborative relationship between the architect and developer at the earliest stages of the planning process, resulting in more informed decisions about the best project to pursue. At the city scale the methodology enables municipalities, developers and the public to explore zoning updates and visioning processes that are grounded in economic realities.

Government and public agencies in the United States no longer have adequate resources to pay for urban social infrastructure or improvements to the public realm. As a result, government officials and their public need to understand how development density can pay for these important programs within the logic of specific design proposals. Intelligent use of available modeling software can allow for a more transparent discussion with affected stakeholders about the relative costs, paid for by additional density, of non-income generating program, associated public benefits, and specific building configurations that relate the project better to the existing urban fabric. BIM software, at first developed as a way to streamline the production of construction documents and to improve the interface between an architect’s specifications and the building industry, can also play a powerful planning role by better aligning good urban design with robust economic development initiatives.
A BIM model was created to inventory the client’s existing holdings and represent them as a 3-D model and in a spreadsheet.

Existing conditions were mapped, revealing that taller, higher-quality buildings are located closest to Congress Street.

The BIM model enabled the team to study several options for increasing density and transitioning to taller buildings along Seaport Boulevard.
Aerial photograph showing the Stuart Street Study Area, adjacent to Boston's Back Bay, South End and Bay Village neighborhoods.

Potential development opportunities are governed by outdated zoning that allows for densities that fall below market thresholds.
The urban design agenda seeks to infill vacant and underdeveloped parcels to help mend the street wall and contribute to ground level activity.

Financial and urban design modeling was done for a range of program types including for-sale and rental residential, office, hotel and retail.